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ABSTRACT

A review of research yields nine conclusions concerning mathematics achievement among rural and urban students. Among them are that currently a national rural vs. non-rural mathematics achievement gap does not exist; at the state level, a rural vs. non-rural achievement gap exists in 40 percent of the states, and that gap is evenly split between favoring and not favoring rural students; and schooling conditions account for about 70 percent of the variance associated with the rural/non-rural state-level achievement gap. It would seem that portrayals of rural inferiority derive from cultural and ideological dominance, even hegemony, and from a long line of misinterpretations of available evidence. Qualitative research yields a better understanding of the importance of locale than most quantitative research, because it investigates the meanings attached to circumstances, places, and other phenomena. The meaningfulness of rural places (and of rurally attuned education) is more likely to exhibit itself in variation, interaction, contradiction, and even paradox than in simple measures of difference on conventionally valued quantities. Future research into the circumstances of rural mathematics education (structural features, equity, adequacy, collective purpose) must consider the meanings of "rural lifeways" as it frames and pursues salient questions. Consideration of these meanings is tantamount to valuing and respecting them, since they are so widely devalued. (Contains 26 references.) (TD)

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Research About Mathematics Achievement in the Rural Circumstance

by Craig B. Howley

Ohio University

October 2002

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Research About Mathematics Achievement in the Rural Circumstance

Craig B. Howley, Ohio University

Interest in the achievement of rural students is understandable, in part, as an issue of equity. Rural education scholars (e.g., Herzog & Pittman, 1995) have pointed out that rural schooling typically has been viewed as deficient. Raymond Williams, professor of literature at Cambridge University and author of perhaps the finest book on the topic of the cultural relationship of country and city, observed (Williams, 1973) that this prejudice is difficult to unseat because metropolitan norms have been established as universal norms. "The World City,"[1] he later wrote, became the paragon and standard of cultural propriety (Williams, 1989). Cultural deficiency, of course, translates rather directly into presumed educational deficiency (see Johnson & Howley, 2000, for a review of Williams's work addressed to rural educators). Does the presumption stand up to evidence (and to current evidence about mathematics achievement, in particular)? And what if it does not?

Historical Background

In the absence of representative historical data on mathematics achievement, we begin with an historical review of academic accomplishment in rural areas, focusing on literacy rates and educational attainment. The data are not comprehensive, but rather illustrate historical tendencies broadly related to educational accomplishment from the mid-20th century up to the present. Illiteracy and educational attainment were regarded as distinctive rural problems as short a time ago as 50 years.

Illiteracy in rural areas. Illiteracy was a condition somewhat more prevalent in rural areas than elsewhere,[2] and within rural areas, illiteracy was somewhat more prevalent in rural-farm as compared to "rural-nonfarm" areas.[3]

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[1] The World City is the standard to which all other settlements are (inappropriately, Williams would have observed) compared, with London being the first world city, followed rapidly by others – Paris, New York, Singapore, and Hong Kong among many others. Cosmopolitan standards, of course, prevail today and are embedded in the phrase "world-class."

[2] Illiteracy in Census reports of this time was self-reported inability to read or write among that portion of the population with fewer than 5 years of formal schooling; those with at least 5 years of schooling were presumed to be literate, a presumption applied by the U.S. Army when it screened draftees during the Second World War.

In 1947, for instance, the illiteracy rate for the nation as a whole (among the population aged 14 years or older) was estimated by the Bureau of the Census at 2.7% (Bureau of the Census, 1948). In rural areas, by comparison, the illiteracy rate (for those aged 14 and older) among the "rural-farm" population was 5.3% (6.5% for males and 4.0% for females) and the "rural-nonfarm" rate was 2.4%. In other words, the illiteracy rate for farmers was about twice the national average.

This seems a wide gap, but it is important to observe that illiterates constituted a very small proportion of the population whatever the locale (nation, rural-farm, or rural-nonfarm). In many discussions, the observation of small practical import was not made, conveniently reinforcing the prevailing misconception of rural cultural, intellectual, and educational inadequacy.

The Census Bureau itself , however, observed that illiteracy at mid-century was continuing to decline for the nation as a whole, and that economic conditions accounted for the small (and persistently shrinking) rural-urban disparities. The anonymous author of the report that articulated this insight (Bureau of the Census, 1953) attributed rural illiteracy to three possible causes: (1) continuous outmigration of rural individuals with more schooling (demographic shifts); (2) the exigencies of operating a family farm (the political economy or farming); and (3) the remoteness of schools (access to educational resources). The Bureau of the Census, at any rate, was not reinforcing the longstanding message of cultural deficiency identified by Williams (1973).

Educational attainment in rural areas. The 1953 report also details *educational attainment* (years of schooling) by locale, with results that parallel those for literacy: average attainment (median years of formal schooling) in "rural farm" areas was 8.5, whereas in "rural nonfarm" areas it was 9.7 and in urban areas 10.8. Comparable data on educational attainment from 1950 to 2000 in rural versus other areas is actually more difficult to assemble than one might imagine. Table 1 is the result of library and Internet research, and it comprises a useful assembly of somewhat inconsistent data. I discovered no source presenting comparable data for the period 1950-

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[3] Rural areas for the 19th and 20th centuries were divided by the Census Bureau into two segments due to the prevalence of agriculture as a way of life: "rural-farm" areas and "rural-nonfarm" areas. The "rural-farm" population included people living on farms (defined as such according to a low annual sales threshold, e.g., $1,000 in 1989); "rural-nonfarm" was the residual rural population. During the course of the 20th century, the rural-farm population shrank from about 65% of the rural population to about 6% by 1990, the last decennial census for which the distinction was made.

2000. Changes in the way the Census Bureau has reported data about educational attainment reflect the portentous changes that transformed rural areas in the 20th century.

Table 1.

Educational Attainment in the United States, for Rural Areas, Urban Areas, and the Nation.

year[a]	rural farm[b]	rural nonfarm[b]	non-metro[c]	Urban/metro[d]	Nation
1952 (YRS)	8.5	9.7	-----	10.8	10.1
(HS+)	(23.2%)	(35.9%)	-----	(42.1%)	(38.4%)
1960 (YRS)	8.8	9.5	9.2	11.1	10.6
(HS+)	(29.5%)	(34.4%)	(33.2%)	(44.3%)	(41.1%)
1970 (YRS)	10.0	11.8	11.6	12.3	12.2
(HS+)	(39.9%)	(48.9%)	(47.9%)	(59.3%)	(55.3%)
1981 (HS+)	63.5%	66.1%	65.9%	73.4%	71%
1991 (HS+)	76.8%	-----	71.8%	80.1%	78.4%
2000 (HS+)	-----	-----	80.0%	83.8%	83.1%

Notes. Census Reports P-20, No. 45, Table 12 (1952); PC(S1)-20, Table 76 (1960); P-20, No. 207, Table 2 (1970); P-20, No. 390, Table 7 (1981); P-20, No. 462, Table 10 (1991); and P-20, No. 536, Table 11 (2000).

a. "YRS" indicates median years of schooling. After the 1970 report, educational attainment was not reported as median years of schooling, but only as percentage of persons completing a specified numbers of years. "HS+" indicates the percentage of persons completing at least 4 years of high school. For 1952 1960, and 1970, this figure is the sum of the percentages for the relevant categories; parentheses indicate these sums. For 1981-2000, apparently equivalent totals were supplied in the captioned tables. For the 1952, 1960, and 1970 data, the statistics pertain to the population 18 years and older, whereas for the 1981, 1991, and 2000 data, the statistics pertain to the population 25 years and older.

b. "Rural-Farm" and "Rural-Nonfarm" categories were eliminated with the 2000 decennial census.

c. "Non-metro" – a county-level designation – appears first in this series of reports in the 1970 Table. The statistic for 1960 is for "rural total," a designation that does not appear in the captioned 1952 Table.

d. The "urban/metro" column gives statistics for all urban areas through the 1960 report, and metropolitan statistics (a county-level designation) thereafter

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About 1950, graduation from high school was hardly the norm among the adult population, and about twice as many *urban* as *rural-farm* adults had graduated from high school (42% versus 23%). By the end of this time period, the Census had given up reporting farm and nonfarm distinctions, "non-metropolitan" had become the moniker for "rural," and educational attainment in metropolitan and non-metropolitan areas was nearly identical. Congruent with the decline of farming as a rural way of life, high school graduation became the expected norm for all Americans. the slight difference in observable rates may be the joint result of continuing outmigration among younger residents and the concurrent disproportionately older population in rural areas.

Conclusion. Information about illiteracy and educational attainment show that for much of the 20th century, rural Americans were somewhat less schooled than other Americans. The comparison is clouded, however, by several ongoing circumstances that prevailed during the century. First, farming, as structured economically until 1950 or so, did not require a large capital investment; it was widely understood, moreover, that one could farm successfully without graduating from high school. Second, those who did complete high school were more likely to *abandon* rural areas, relocating to urban areas to pursue industrial employment or, after receiving university credentials, to take up metropolitan careers. Such outmigration was not a trickle, but a torrent during the century; some astute observers have characterized it as a sort of *hemorrhaging* (e.g., Berry, 1978/1990; Gruchow, 1995). Third, and as a result of the previous fact, academic talent was certainly exported to the metropolis, so that rural areas were a major contributor of "human resources" to the construction of an industrialized and bureaucratized 20th century America. The accomplishments of rural migrants to urban areas are inextricably conflated with those of non-migrants. In view of such facts, it is a sort of wonder that rural areas no longer exhibit "deficiencies" in literacy and attainment once buttressed by hard data. With this recently achieved "parity of academic standing," we might expect that, overall, rural achievement levels in mathematics would differ but slightly from those prevailing elsewhere.

National Assessment of Educational Progress Reports of Rural Mathematics Achievement

Consistent information on the contemporary mathematics achievement of rural students is somewhat easier to assemble than information on the historic levels of literacy and educational attainment in rural areas. Part of the reason for the comparative ease is that the time indicated by "contemporary" is shorter (e.g., 1975-2000). For the

most part, however, the ease is the result of the fact that the National Assessment of Educational Progress (NAEP) has provided comparable reports of mathematics achievement nationally since 1978,[4] and at the state level since 1992, beginning with a state-level "trial assessment" that year. In the first part of the discussion, we examine national aggregations based on official NAEP reports that provide only descriptive data.

NAEP reports provide an excellent baseline of descriptive data for the last quarter of the 20th century, but from the perspective of scientific research, the reported scores do not provide a sufficiently complete account of reality. That is, official NAEP reports test no theories or hypotheses and cannot by themselves provide much insight into the causes of any observed differences or variations. NAEP has been very careful, nonetheless, to distinguish statistically nonsignificant from statistically significant differences among states and to provide the basis for making the distinctions among variously constituted population subgroups.

Interpreting NAEP data for the last quarter of the 20th century requires some understanding of the changes in the administration and design of NAEP from 1978 to 2000. From 1978 through 1992, NAEP's rural category was "extreme rural" (contrasting "extreme rural," for instance, with "advantaged urban" and "disadvantaged urban" locales). These three (disadvantaged) locales[5] each represented about 10% of the school-age population. "Extreme rural" was synonymous with open countryside and was portrayed in NAEP reports from about 1970 as home to farm families and agricultural workers – even as this characterization was becoming less and less apt. Worse still, the function of locale in this conception was essentially to draw a geographic line around disadvantaged groups. This analytic approach constituted a deficit model of locale.

Starting in 1996, this shortcoming (apparent to rural education researchers and others) was corrected. For 1996 and 2000, locale breakouts of NAEP data were inclusive of all students, not just an exceptional fraction understood as disadvantaged or somehow deficient. The new categories were "central city" (central cities of Metropolitan Statistical Areas); "urban fringe/large town" (metro areas adjacent to the central cities of 250,000 or more population and towns of population 25,000 to 50,000); and "rural/small town" (non-metro towns of no more

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[4] NAEP began operations in 1969 and produced its first mathematics assessment in 1976. The 1976 data are not comparable to those provided in later years, especially as the U.S. Department of Education assumed management of the program, which had begun under the auspices of the Education Commission of the States.

[5] "Extreme rural" is essentially a disadvantaged locale through the association of remoteness and poverty.

than 25,000 plus outside towns or villages of 2,500 or less and the open countryside in both metro and non-metro areas).[6]

In 1992, NAEP began to replace its previous assessment system, which provided only national estimates of achievement, with a system that now incorporates state-level estimates, and thus provides researchers the opportunity to investigate variability among state systems, including rural within-state comparisons (NAEP itself reports mean differences but does not usually attempt to sort out relationships among contributing influences).

Finally, it is important to recognize that scores generated by the NAEP testing and reporting system are, for each student tested, *predicted* and not actual scores. Each student takes a fraction of the entire assessment, and procedures based on Item Response Theory predict the score a student would have received had the whole test been administered. This system makes using NAEP data in research a particular challenge, but there seems to be little doubt that aggregations at the state and national level provide valid and reliable assessments of aggregate achievement levels.

Table 2 reports NAEP data about the mathematics achievement of rural students from the national assessments from 1978 through 1992. Table 3 reports data about rural student achievement from the 1996 and 2000 assessments.

[6] See Johnson (1988) and U.S. Department of Education (2002) for further details on the development and use of "locale codes." Johnson provides the original development and the latter citation the current overview, as well as links to numbers of schools, districts, and students by locale.

Table 2

Grade	Locale	Year				
		1978	1982	1986	1990	1992
4	nation	218	219	221	230	218
	extreme rural	212	211	219	231	216
	difference	-6	-8•	-2	+1	-2
8	nation	264	268	269	270	268
	extreme rural	255	258	270	265	267
	difference	-9•	-10•	+1	-5	-1
12	nation	301	299	302	305	299
	extreme rural	295	293	305	304	293
	difference	-6•	-6•	+3	-1	-6

NAEP Scale Scores for 1978-1992, national means versus "extreme rural" means

Notes. Source for 1978-1990: Stern (1994, p. 110); Source for 1992: (Mullis et al., 1993)
• = difference significance at $p \leq .05$ (1978-1990 per Stern; 1992 difference computed by author as standard error difference based on reported SEMs ($SEM_{dif} = SQRT[(SEM_1)^2 + (SEM_2)^2]$.

Table 3

NAEP Mathematics Scores for Rural/Small Town Students, 1996 and 2000

Grade	Locale	Year 1996	2000
4	nation	**224**	**228**
	central city	218	222
	urban fringe	229	232
	rural/small town	**222**	**227**
	difference	-2	-1
8	nation	**272**	**275**
	central city	265	268
	urban fringe	275	280
	rural/small town	**276**	**276**
	difference	+4	+1
12	nation	**304**	**301**
	central city	301	298
	urban fringe	309	304
	rural/small town	**301**	**300**
	difference	-3	-1

Sources: Locale means from National Center for Education Statistics (2002). National means from Braswell et al., 2001. Differences listed are those prevailing between rural/small town means and national means. None of the listed differences is statistically significant (differences computed by author using standard error of difference, see Table 3 Note).

As suggested previously, the 1992 and 1996 "rural" means are by no means comparable, since they represent the performance of substantially different populations.[7] Observed differences can, however, be computed and their statistical significance calculated on the basis of standard errors provided in the reports. Although the observed differences (+6, +9, and +7, for grades 4, 8, and 12) are statistically significant at the 8th and 10th grade levels, this difference is doubtless explained by population differences (particularly socioeconomic status).

[7] Across the three grade levels, the "rural/small town" portion of the NAEP sample constitutes approximately 30% of all cases, as compared to the 10% of "extreme rural."

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Two inferences about trends seem evident. First, across 25 years of testing, there has been little change – increase or decrease – in the mathematics performance of rural students. Second, the performance of rural students differs not at all from the national average in all this time.

The second claim needs some justification, since Tables 2 and 3 show negative values in about two-thirds of the "difference" cells, and this fact might appear to indicate a deficit. Most of the given differences, of course, are not statistically significant. But, still, one might wish to know the practical significance of those that are? We can answer that question by calculating effect sizes.

Differences (including statistically significant observed differences) in recent research are often interpreted as "effect sizes." Effect sizes give the change in standard deviation units associated with a treatment or a condition – and such a condition might well be "locale." Moderate effect sizes are in the range of +/- 0.20 to +/- 0.50, with strong effect sizes ranging from +/- 0.50 and up.

What sorts of effect sizes would the differences provided in Tables 2 and 3 represent (rural average as compared to national average)? The largest difference (-10, significant at $p < 0.05$) in both Tables is for the 1982 8th grade. It represents an effect size of roughly -0.25 (based on an approximate standard deviation of 40). Since 1986, however, *none* of the differences has attained statistical significance: the observable differences are thus likely the result of chance alone.

On the basis of nearly 25 years of descriptive data supplied by the National Assessment of Educational Progress – and entirely without controls for influential background conditions – casual observers have little evidence on which to base a claim that the mathematics achievement of rural students as compared to the national average (or even to all other students) is deficient. The observed differences are small; the practical import of pre-1986 statistically significant differences is doubtful; and observed positive differences are almost as frequent as observed negative differences – though none of the positive differences proves statistically significant.

Current Research on Math Achievement in Rural Areas

We turn now to empirical studies with an explicit base in theory. The extant literature is indeed thin, but three excellent recent studies nonetheless provide a surprisingly comprehensive picture of mathematics achievement among rural students.

Haller, Monk and Tien (1993). Emil Haller, David Monk, and Lydia Tien (1993) examined the 1987-1989 mathematics scores of 10th grade students on tests administered by the Longitudinal Study of American Youth (LSAY), a panel study of mathematics and science achievement funded by the National Science Foundation. The Haller team was concerned to test the hypothesis that the lack of significant difference in test scores for students in small, rural communities – commonly demonstrated in previous studies (based largely on different tests and samples among state-level studies) – was principally the result of norm-referenced tests with "inauthentic" items not assessing "higher-order thinking." The LSAY tests were constructed using items developed by NAEP and were thus notably different from norm-referenced measures used in the previous literature at that time. Haller and colleagues detail the way in which the NAEP-developed items more closely reflect achievement related to "higher-order thinking." The sample was nationally representative (including nearly 2,300 12th grade students from 51 schools). Tests included both mathematics and science.

For Haller and colleagues the issue was the possible handicap that rural status and small school size – especially the association of smaller rural high schools with fewer advanced mathematics and science – might impose on "higher-order" learning. Controls included in the study's regression analysis included school size, rurality, poverty, advanced course offerings, and enrollment rates in the advanced courses.

In zero-order correlational analysis, neither rurality nor school size, perhaps surprisingly, had a statistically significant influence on the outcome measures, including higher-order learning in mathematics. The *number of advanced course offerings* showed no relationship with either outcome measure, but the rate of student participation in advanced course offerings (i.e., whether meager or ample) did show such a relationship ($r = +0.38$ for mathematics). In regression analysis, the only significant predictor variable was prior achievement. Haller and Monk (1993, p. 71) conclude, "While large schools offer more advanced courses than do small ones, those offerings appear to have no influence on average levels of student achievement." Indeed, this study suggests that observation also pertains to the higher-order skills of "identifying and using a problem-solving strategy, screening relevant information, formulating a problem or selecting a model of a problem situation, determining what information would be needed to solve a problem, and organizing given information to represent a problem" (Haller et al., 1993, p. 68). As it relates to the often more narrow mathematics curriculum of rural schools, this conclusion is quite provocative.

One possible shortcoming of the study by Haller and colleagues is its use of a nationally representative dataset. Regional and, most particularly, state-level conditions (economics, politics, history, culture of education policy making, and so forth) exert very strong influences on schooling. These influences are sufficiently strong, in fact, to structure sharp differences at state and regional levels (e.g., Rural Trust, 2000). National data – as in the NAEP reports and in Haller and colleagues (1993) – answer an important question at the same time that they raise additional questions about variability at levels closer to the classroom level: regions, states, districts, and schools. In addition, the number of schools involved (N=51) may embed a restriction-of-range problem for rurality and size, although the authors state that schools – not students – were selected in a random sample proportional to enrollment size in 12 sampling strata. Nonetheless, 51 schools seems a size unlikely to capture well the locale or size variability of 25,000 high schools.

Fan and Chen (1999). Xitao Fan and Michael Chen (1999) published an assessment of the academic achievement of rural students as compared to suburban and urban students and which included regional comparisons. They examined test scores for reading, mathematics, science, and social studies using the National Educational Longitudinal Survey (NELS:88) data set. Separate analyses were conducted for 8th, 10th, and 12th grade students. Again (as with the previously considered report), mathematics was one among several achievement outcomes studied. These researchers were concerned primarily to provide a systematic test of the hypothesis (prevalent also in the culturally inscribed cosmopolitan view of rural deficiency) that rural students in the U.S. received an inferior education compared with their metropolitan counterparts, with parity of achievement the criterion. Methodologically, Fan and Chen were particularly concerned to overcome five shortcomings of previous studies: sampling issues, inconsistent definitions of locale, socioeconomic status, ethnicity, and sector as potentially confounding variables.

The analyses were carefully executed and comparatively sophisticated, and the results are very simply stated: with careful controls in place, no practically significant differences between test scores existed by locale (rural, suburban, and urban). *This includes locale comparisons by ethnicity, region of the nation, grade level, sector, and even for Caucasian students by locale by region.* Small, statistically significant differences were found, but with large sample sizes, the effect sizes of these small differences (generally *es* <0.01) were judged to be of no practical importance whatever. Marginal means (adjusted for the influence of SES) were higher in private than in

public schools, though the authors did not compute ANCOVA statistics for this comparison since between-sector comparisons were not a focus of study (allowing them, of course, to avoid that controversy!). Within sectors, though, there were no meaningful differences by locale (e.g., rural private students performed comparably to their urban and suburban counterparts).

The Fan and Chen data do, of course, exhibit the familiar achievement differences that plague the U.S. educational system – those contingent on ethnicity and socioeconomic status – but within comparison groups they found few significant differences by locale, and none that would be reasonably judged as practically important. In sum, looking systematically for differences between rural students and other students, Fan and Chen (1999) found none.

Lee and McIntire (2000). Jaekyung Lee and Walter McIntire (2000) used NAEP 8th grade data for 1992 and 1996 to investigate state-level variability in rural versus non-rural mathematics achievement, as well as to investigate the potential influence of six "schooling conditions" on that variability. In these data, information from 35 states was available for comparison. The study also examined state-level changes for rural and non-rural student segments from 1992 to 1996. Lee and McIntire's six schooling conditions were derived from perceptions self-reported to NAEP by teachers and principals: (1) instructional resources (percentage of teachers responding all or most to a question about provision of resources for teaching mathematics); (2) professional training (based on 11 NAEP items having to do with training or course-taking); (3) 8th grade algebra offering (one NAEP item: yes or no); (4) progressive instruction (10 items concerning small-groups, calculator use, and so forth); (5) safe/orderly climate (7 items relating to school-level disorder); and (6) collective support (7 items about school-level relationships). This study, among the two others cited, is notable for its specific consideration of *mathematics* achievement. This focus of course, is the circumstance that allowed the researchers to make hypotheses about, and investigate the variation in, the conditions of mathematics instruction that might influence rural mathematics achievement at the state level as well as at the national level.

Lee and McIntire first reported national averages for the rural/non-rural comparisons. The results, of course, are consistent with those reported in Tables 2 and 3, except that in this case the comparison is not between rural students and the national average, but between rural and all others (i.e., non-rural), and using consistent locale codes. For 1992, the national-level difference is 265 (rural) versus 267 (non-rural), and was not statistically

significant. For 1996, the rural mean was 276 and the non-rural mean was 268. With standard errors of 1.92 and 1.80, the implied standard error of the difference (5.26) indicates a statistically significant difference in 1996 favoring rural students. The difference equates to an effect size of +0.23. This *positive* difference (favoring rural students) is equal in magnitude to the largest pre-1986 *negative* difference between disadvantaged "extreme rural" and the national average, noted previously in the discussion of historical NAEP reports.

Results for the 1992 and 1996 assessments, predictably, varied a great deal at the state level. In some states, the non-rural portion of the population performed substantially higher than the rural portion, and in other states there was no significant difference. In fact, in 21 of the 35 states with data for both years, a statistically significant rural vs. non-rural gap did not exist. In the 14 with such gaps, however, the direction (+ or -) of the difference varied, and in fact, in half these states, and contrary to the national average, non-rural student aggregate scores were higher than those of rural students (Georgia, Kentucky, Maryland, North Carolina, South Carolina, Virginia, and West Virginia).

Such state-level differences, of course, can hypothetically be accounted for, at least in part, by differences in the conditions of schooling. These conditions themselves are hypothetically linked to state-level policies regulating or shaping the way districts, schools, and classrooms operate. In this study, those conditions were limited to the six "schooling conditions" previously described. Across the 35 state cases, these six conditions, in regression analysis, account for fully 84% of the variation in state-level NAEP 8th grade mathematics achievement among the rural portions of the respective states' populations; the comparable statistic for the non-rural segment was 69% (still high). According to the researchers,

> *Rural students* in states where they have access to instructional support, safe/orderly climate, and collective support tend to perform better than their counterparts in states where they don't. (emphasis added; Lee and McIntire, 2000, p. 171)

It's important to observe, however, that the magnitude of these correlations across the two years changed substantially for some of the conditions. Progressive instruction, in fact, was moderately related (r = 0.52) to 1992 achievement for non-rural, but not for rural, students. Among rural students in 1992, the correlation was r = 0.70,

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accounting for *nearly 50%* of the variance in state-level achievement, but in 1996, the correlation was a more moderate r = 0.50, accounting for just 25% of the variance in state-level rural achievement, the same as for non-rural students in 1992. The analysis, comparatively fine-grained as it may be, is not necessarily sufficiently fine-grained to justify generalizing the conclusion to future years. Instead, these data provide substantial material for hypotheses in subsequent studies.

The researchers also correlated state-level differences in rural vs. non-rural achievement with state-level rural vs. non-rural differences in the six conditions of schooling, for both 1992 and 1996.[8] The strength of the association of these difference measures varies across the years, but Lee and McIntire report that jointly in multiple regression, the six conditions account for about 45% of the variance in the achievement gap. On this basis, they conclude that parity of schooling conditions is associated with minimizing or eliminating the state-level rural/non-rural achievement gap. The researchers illustrated this conclusion with a contrast of schooling conditions in Connecticut and Virginia: favorable rural learning conditions existed in Connecticut, where rural students exhibited higher scores than non-rural students. In Virginia, the opposite case prevailed.

Lee and McIntire also examined conditions associated with rural achievement gains from 1992 to 1996. The researchers contrasted 12 states with statistically significant gains for their rural populations with 23 states where such gains were not evident; they concluded that the gains were associated with the conditions of schooling (using boxplots to indicate central tendencies and range for the standardized dependent and independent gain variables). Such an exhibit (see Lee and McIntire, Figures 2 and 3, pp. 175-76) supplies some warrant for the claim, but a comparatively weak one.

The analyses presented by Lee and McIntire (2000) are not conclusive, but they do illustrate quite nicely the complexity of the landscape of rural mathematics achievement at state and national levels. In particular, they

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[8] There is a serious potential threat to such an analysis, however. Recall that the national difference for 1996 favors the rural portion of the population over the non-rural, to a statistically significant degree. Analysis at the state level, however, mutes the conclusion of rural superiority. In only 14 of 35 states is there a statistically significant rural/non-rural difference, and in half of those comparisons, the non-rural portion of the population exhibits aggregate scores higher than those of the rural portion. The difference at the national level indicates the possibility that the composition of state student populations (rural vs. non-rural) explains the rural-non-rural achievement gaps (or lack thereof) at the state level. Correlations between the achievement gaps and state-level percent rural student population were r = 0.21 (1992) and r = 0.29 (1996)—thus accounting for between 4% and 9% of the shared variance. The researchers judged it a modest threat and proceeded to correlate the two difference measures.

point out that the most interesting and useful work to be done lies below the national level, and ought particularly to address issues of state context.

Conclusions

A number of conclusions seem reasonable in view of the foregoing discussion, and together they point to an historical convergence, with prevailing national norms, of educational outcomes in rural places. Since about 1975, as well, it seems clear that this national convergence is reflected in levels of mathematics achievement, whether statistically controlled for the effects of poverty and other influences or not. Nine specific conclusions seem evident:

- historically, in the first half of the 20th century, when farming was a substantial occupational choice for Americans, literacy rates and especially educational attainment rates were lowest in "rural-farm" and somewhat lower in "rural-nonfarm" areas as compared to those in metropolitan areas;
- historically, as farming declined as an occupational choice for Americans in the latter half of the 20th century, rural literacy rates and educational attainment rates increasingly approximated those in metropolitan areas;
- historically, metropolitan and non-metropolitan rates of educational attainment had converged by the close of the 20th century;
- historically, a rural vs. urban mathematics achievement gap seems to have existed at the start of the last quarter of the 20th century;
- currently, a national rural vs. non-rural mathematics achievement gap *does not* exist;
- currently, neither a national rural vs. suburban, nor a national rural vs. urban mathematics achievement gap exists;
- currently, at the state level, a rural/non-rural achievement gap exists in just 40% of the states;
- currently, in 20% of states, the rural/non-rural achievement gap favors non-rural students; and
- currently, in 20% of states, the rural/non-rural achievement gap favors rural students;
- conditions of schooling account (variably) for about 70% of the variance associated with the rural/non-

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rural state-level achievement gap.

Rural Mathematics Education: The Place of Meaning and the Practical Meaning of Place

Skip Kifer (2001) quite rightly advises that comparisons of *variation* rather than of *averages* constitute the most important work for researchers. This assertion is very apt, but when the charge of inferiority does obtain, as it unfortunately has in the case of rural culture, lifeways, and talents, falsification of the charge based on study of averages has considerable practical and theoretical merit. Rural people have struggled under the burden of cosmopolitan portrayals that render them as ill-informed, uneducated, and stupid (e.g., Williams, 1973; Herzog & Pittman, 1995). Jim Goad (1997), in particular, points out that anyone can ridicule rural Appalachians without suffering criticism for unfair discrimination – except from Appalachians, of course, whose complaints need not be regarded seriously by those sponsoring the ridicule. The basis of their safety is cultural power, not (of course) justice.

One seminal sociological study[9] of educational, occupational, and economic attainment among adults with rural origins (Howell, Tung, and Wade-Harper, 1996), found that, historically, the effect of rural origins has been mediated by educational attainment, which in turn was shaped by the expectation of parents and peers for less schooling: "the influences of parents and friends serve to transmit the lion's share of the negative effect of rural origins" (p. 82). In other words, across the entire twentieth century, it appears that farming culture and limited access to schooling (cf. Bureau of the Census, 1953) may well have been causally responsible for the observed differences in the educational, occupational, and economic standing of rural versus urban citizens.

These researchers also found, in their analyses of data about the most recent rural development period, that rural-to-urban migration produced a predicted increase of about $3,200 in adult family income (1985 constant dollars), whereas urban-to-rural migration produced a similar decrease in predicted adult family income (p. 62). This finding, combined with the demonstrated convergence in educational attainment and performance in rural as compared to other areas (see the preceding analyses in this paper), rather strongly suggests that *rural residence*

[9] This was a longitudinal study examining relationships across six "rural development periods " from 1900 to 1980, using two large databases: the General Social Survey and the National Longitudinal Study of 1972, the latter enabling an extensive investigation of influences on adult attainment among people who were high school seniors in 1972. The NLS-72 analyses, therefore, were applicable only to the most recent "rural development period."

alone exerts a negative effect on adult occupational status and income.[10] Indeed, Howell and colleagues (1996) conclude,

> In short, one inference from the NLS-72 data is that it seems to be rural areas [per se] that produce lower family incomes rather than the socioeconomic origins or human capital characteristics of persons choosing to remain there or to move there from urban origins. (p. 83)

Such analyses as those of Howell and colleagues and the preceding synthesis that demonstrates achievement parity now strongly warrant the view that portrayals of inferiority derive from cultural and ideological dominance (even hegemony) and from a long line of misinterpretations of available evidence. Clearly, it is time for researchers to take up Kifer's challenge to examine variation within the rural context more closely.

Circumstances of likely interest. As Lee & McIntire (2000) show, variability exists at the state level, sometimes favoring rural students and sometimes not. This is something of a beginning. We can be certain, however, that conceptually and practically interesting variability is greater still at the district, school, and classroom levels. Some of this potentially interesting variability might be random, so that it harbors few practical implications. But much of it is probably not random. Much of it may be related to features of the rural circumstance over which humans might exert some influence for the common good of more and better mathematics learning. What might such circumstances be?

- structural features of the educational system (e.g., class size, school size, district size, and the relationships among them);
- equity of local resources (e.g., income distribution in the community, parity of instructional resources among district schools, patterns of assignment of the best teachers among a district's schools, and so forth);
- the local culture of schooling (e.g., the extent to which the school is embedded in the community, and vice versa, conceptions of educational purposes and effects, and so forth);

[10] Ironically, the GSS analyses suggest *no* systematic effects of migration earlier in the twentieth century: during the first three-quarters of the century, rural youth moved in great numbers to urban areas in the expectation of social and economic benefits, but this migration is shown by Howell and colleagues (1996) *not* to have yielded these benefits systematically.

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- intentions of teachers and administrators (e.g., school climate, professional collegiality, relationships among students and between students and educators, and so forth);
- adequacy of resources (e.g., school funding levels in view of challenges, tax effort, staff turnover, and so forth); and
- degree of collective purpose (e.g., student-centered focus, extent of tracking, equity of educational outcomes, and so forth).

Many studies, of course, have considered these issues, but practically no investigation of them with respect to mathematics achievement in rural schools and districts has as yet been attempted.

Contradictions, dilemmas, and complexities. Some work related to rural achievement (including mathematics achievement) has been done with respect to the first of these circumstances, structural issues of size and scale (e.g., Bickel & Howley, 2001). This circumstance is important to rural communities for two reasons: (1) because schools and districts are smaller than elsewhere, and (2) because state-level consolidation efforts continue to make both schools and districts larger. In a series of replication studies in various states, Bickel and Howley (e.g., Bickel & Howley, 2001; Howley & Bickel, 1999) developed findings that pose challenges to policy making. First, they showed that size exerts a positive influence on achievement only in the most affluent communities; elsewhere the influence is negative, and it is most sharply negative in the most impoverished communities. Second, these studies consistently found that smaller schools and districts disrupt the relationship between socioeconomic status and achievement. Third, results include significant cross-level interactions between school and district size such that large districts combined with large schools compound educational disadvantages in impoverished communities. Interpreting these findings to policy makers is difficult enough; suggesting practical courses for policy making is even more difficult, which means that even the most thoughtful policy recommendations will exhibit infidelity not merely to the research findings but to a proper (and respectful) research agenda.

The relationship of rural lifeways to future research. The American preoccupation with excellence and the simultaneous American bad faith with respect to equity have produced a dilemma for rural education. By bad faith, I mean several things. First, the United States, though perhaps the wealthiest nation on the planet, is also one of the most inequitable among developed nations. Second, despite this situation, and also because of it, liberal Americans have spent much effort and energy to address the symptoms of inequity. Educational outcomes are symptomatic of

inequity, so that in order to appear worthy of attention and support (liberality), rural inequities have been dramatized, by journalists, practitioners, and researchers. On these terms, the findings summarized here would *not* actually be considered good news by most rural practitioners, nor by many researchers. Such findings constitute a threat to the established political economy of interest that secures attention to rural issues.

Mean differences, of course, are not the point with research into the conditions of rural education. As Kifer notes,

> Educational research, unfortunately, often focuses on findings of statistical difference between overall means or averages. Most media reports of results of such research routinely give those differences and little else: they report means and mean differences as though that is all one needs to know in order to understand the findings of the research and what the implications might be for practice. (Kifer, 2001, p. 44)

In fact, qualitative researchers – whose work is seldom considered by popular media – have a better understanding of the importance of locale than many quantitative researchers. Unlike most quantitative researchers (whose work is the object of the preceding synthesis), most qualitative researchers are interested to discover and articulate the *meanings* attached to circumstances, places, and other phenomena. The meaningfulness of rural places (and of rurally attuned educations) is more likely to exhibit itself in variation, interaction, contradiction, dilemma, and even paradox than in simple measures of difference on conventionally (e.g., nationally) valued quantities.

Future research into the foregoing circumstances of rural mathematics education (e.g., structural features, equity and adequacy, collective purpose) must consider the meanings of *rural lifeways* as it frames and pursues salient questions. Consideration of these meanings is tantamount to valuing them, since they are (as Raymond Williams insisted) so widely devalued. In a recent essay on the topic of doing research into mathematics and science education in rural contexts, I claimed,

> If you don't respect something, you shouldn't study it. Far from harboring a bias, a respectful stance *actively constitutes objectivity*. The deficit view is a hidden bias that's fatal to the object of study.

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(Howley, 2001, p. 19).

Respect does not mean approval, but unlike lack of respect, it harbors the possibility of approval.

Quite narrow quantitative studies can, and should be, informed by such meanings. But rather than seeking simple differences, future quantitative studies should consider variation, interactions, dilemmas, and contradictions, for these are the challenges that make practice and improvement difficult. Such studies, however, are far less likely to unfold without an informative base of qualitative studies that articulate rural meanings in the context of mathematics knowledge at work – in and out of rural schools. As yet, hardly any such research exists, and, for that reason, it is no wonder the existing quantitative research base is so thin.

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